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NEW METHOD OF LIMB DEFORMITIES CORRECTION IN CHILDREN

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FOR ALMOST 40 YEARS Dr. G. A. Ilizarov of the Soviet Union has been developing a system of orthopedic traumatology that utilizes transfixion wires and a circular external skeletal fixator. When combined with biologic principles he discovered in the 1960s,[5,6] the Ilizarov method allows surgeons to manage a variety of difficult clinical problems in a new way. To date, 52 Ilizarov procedures have been performed in our hospital in 36 children with a variety of limb deformities. We report here the results in 29 children who have completed the treatment.

PATIENTS AND METHODS

29 children underwent 36 Ilizarov procedures during the period 1987–1989. Seven patients underwent bilateral procedures: 12 girls and 17 boys.

Fig. 1*a,b.* Severe rigid equino varus foot with claw toes before correction

Average age at the time of the operation was nine years (range four–18). They were divided into seven groups according to the indications for the surgery: leg length discrepancy—six (four congenital, two acquired after infection), achondroplasia—five, pseudoarthrosis—five, deformed foot—four, joint contractures—five, rotational deformity—one, external fixator after corrective osteotomy—three.

The technique used is the Ilizarov method.[5,6,8] Detailed technique is beyond the scope of this manuscript. Weight bearing in conjunction with physiotherapy (range of motion of the knee and ankle) was commenced one day after surgery. During their stay in the hospital (average 17 days, range six–40 days) parents (and children) were taught how to distract the apparatus and wire cleansing procedures. After discharge patients were monitored weekly in the outpatient clinic.

Results

Four feet with moderate to severe equino-varus deformities were treated (two cerebral palsy patients and two spina bifida). Ilizarov apparatus was removed after average of 63 days (range 32–117 days). Patients were then placed in a short leg cast for a month and since then in an ankle-foot orthosis brace. There was only one complication. One patient had a superficial pin

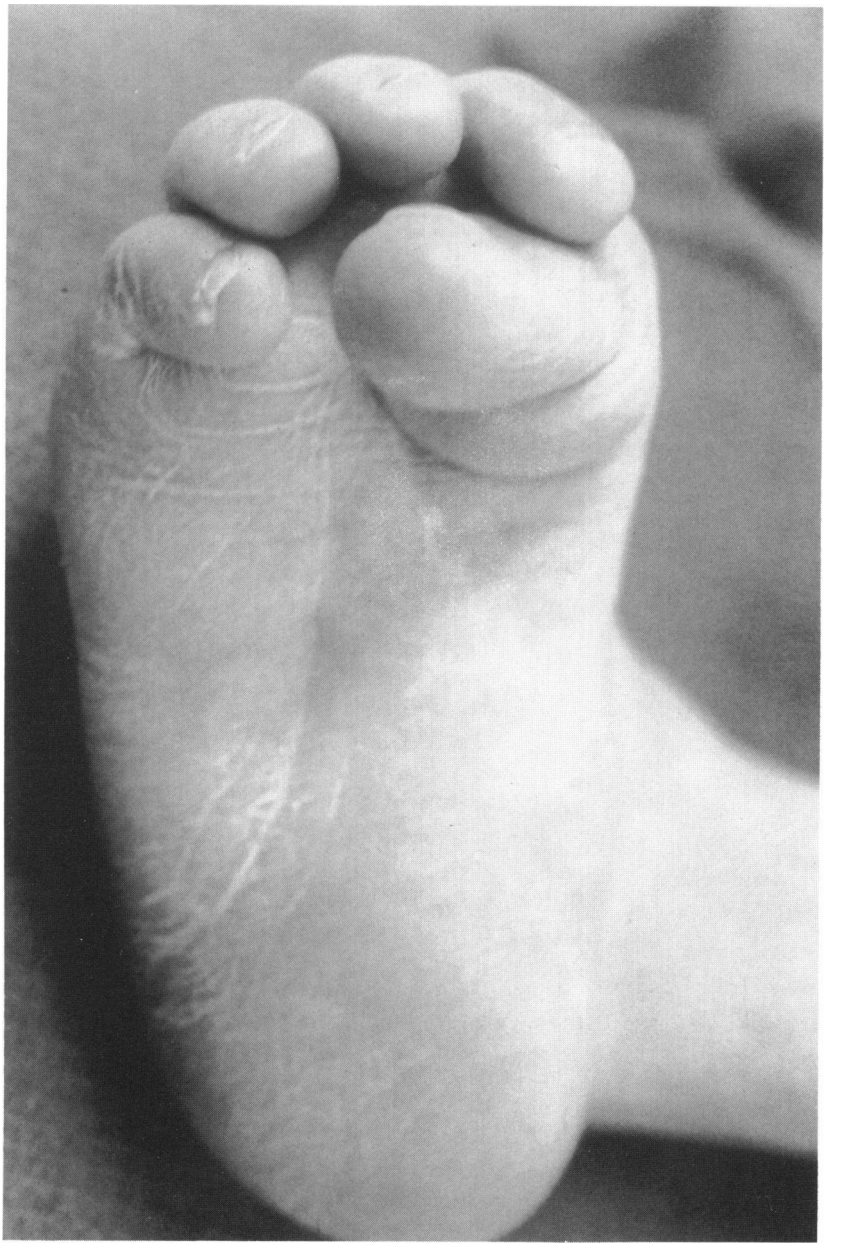

Fig. 1. Part b.

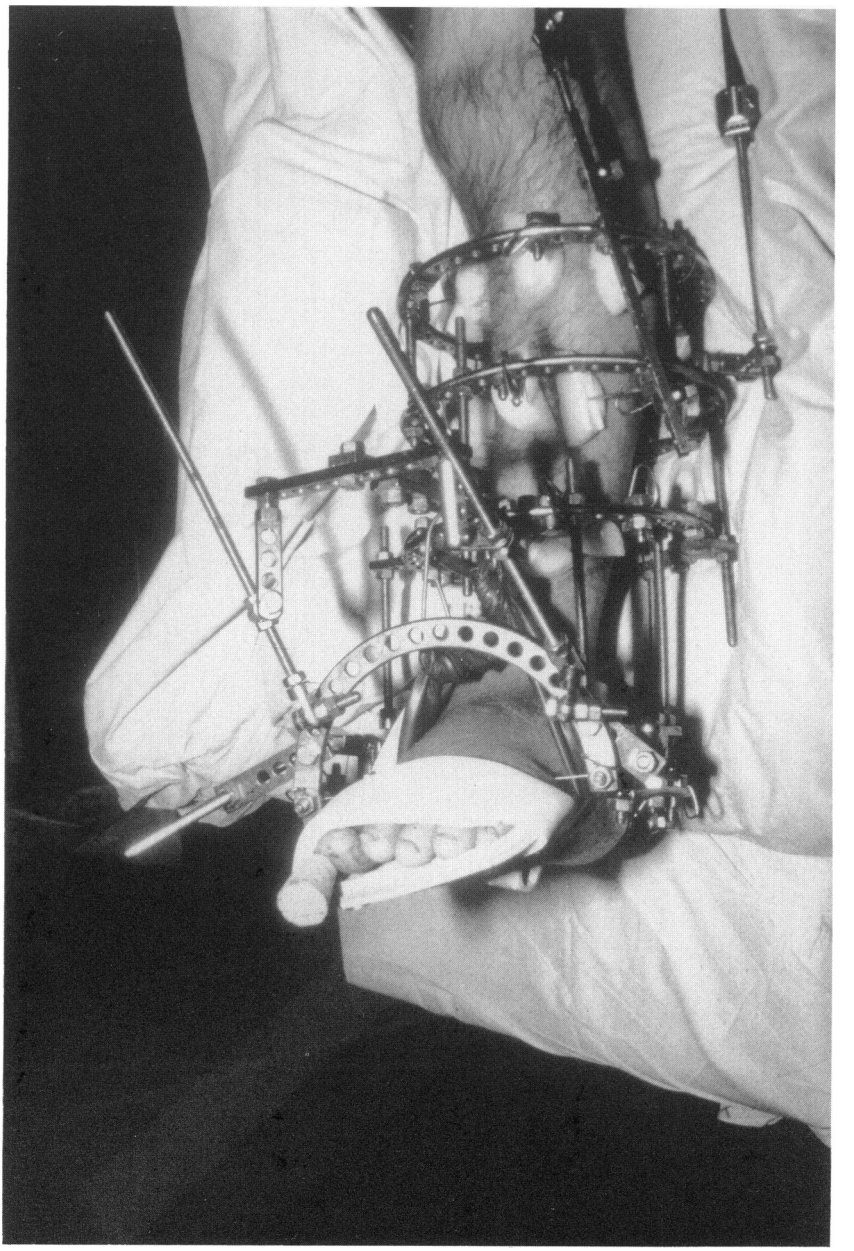

Fig. 1*c*. During correction with the Ilizarov apparatus on in place.

Fig. 1*d*. After correction anteroposterior.

Fig. 1*e*. Lateral view.

site infection, treated successfully by antibiotics. The follow up period averaged 10 months (range five–20 months). All patients have fully corrected feet (Figures 1*a–d*).

Six patients with leg length discrepancy of 9 cm in the femora and 5 cm in the tibia were treated (Figures 2*a–e*). Lengthening was accomplished in five patients. Overall treatment time in days averaged 280 days (range 210–262). Percentage increase in initial length of segments: Femur—30% (range 30–33%), tibia—25% (range 25–26%). Several complications occurred: pin sites infection (two), transient nerve injury (two), vascular injury (one), premature consolidation (one), joint dislocation (one), stiff knee (one), and fracture after apparatus removal (one).

Only in one patient out of four with congenital pseudoarthrosis was bony union achieved (Figures 3*a–d*). One patient with atrophic nonunion after closed fracture of tibia in a road accident also had bony union. Few complications occurred: pin site infections (three) and fracture after apparatus removal (one).

In three out of five patients with joint contractures the procedure was successful (Figures 4*a–e*). Average follow up was seven months (range five–11 months). In one patient, procedure was stopped and apparatus removed because of lack of cooperation by the patient and his family. In one patient,

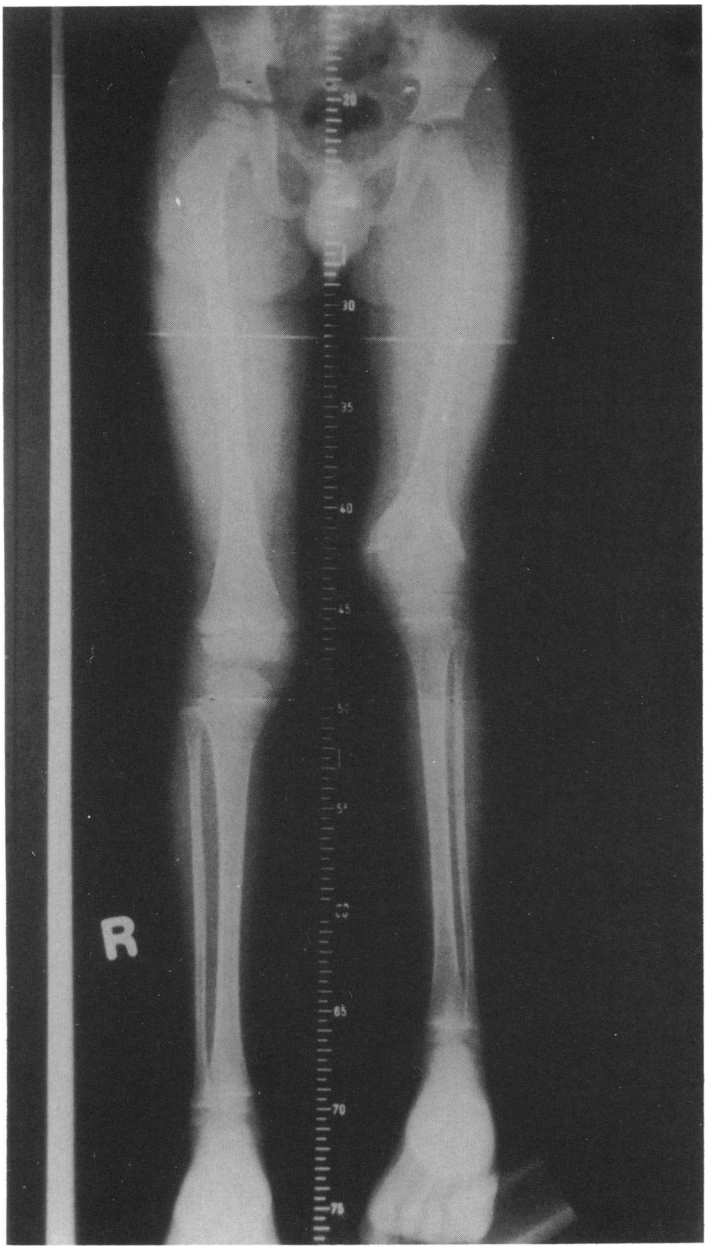

Fig. 2*a*. X-ray shows leg length discrepancy of 10 cm. Reproduced by permission from Atar, D. et al.: Treatment of complex limb deformities in children with the Ilizarov technique. *Orthopedics 14(9):* 961–67, 1991.

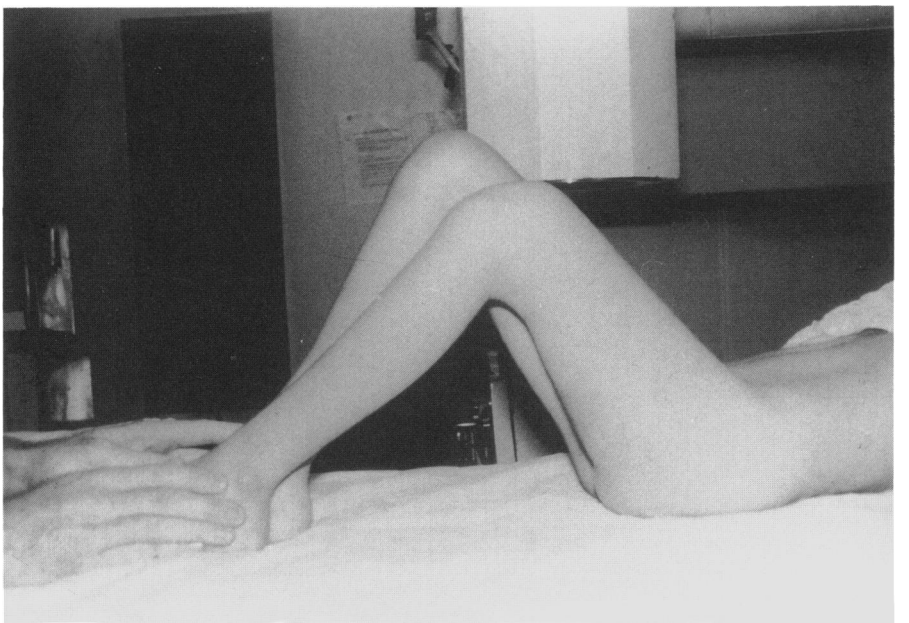

Fig. 2*b*. Clinical appearance of the left short femur. Reproduced by permission from Atar, D. et al.: Treatment of complex limb deformities in children with the Ilizarov technique. *Orthopedics 14(9):* 961–67, 1991.

the deformity had partially recurred. There were two pin-site infections, one posterior subluxation of the knee, and one stiff knee.

Ten procedures were performed in five achondroplastic patients: seven tibiae, one femur, and two humeri (Figures 5*a–d*). Seven tibiae were lengthened, average of 9.8 cm (range three–10), one femur was lengthened by 7 cm, two humeri were lengthened by 11 cm each. The overall treatment time in days averaged 246 days (range 120–360 days). Percentage increase in initial length of segments: femur 35%, tibia 34% (range 15–50%), and humerus 40%. In four patients premature consolidation occurred. One had pin-site infection, one transient nerve injury, two joint contractures, and in two patients fracture occurred after apparatus removal.

One patient with cerebral palsy and external rotation of tibia (30°) was corrected gradually by Ilizarov apparatus with only one readjustment under general anesthesia and no other complications.

Three patients with adolescent Blount's disease had the corrective osteotomy externally fixed by the Ilizarov apparatus. Two had no complications; one had pin-site infection treated successfully by antibiotics.

Discussion

The apparatus designed by Dr. Ilizarov consists of a number of standardized interchangeable components that make it very versatile. Transfixion K-wires

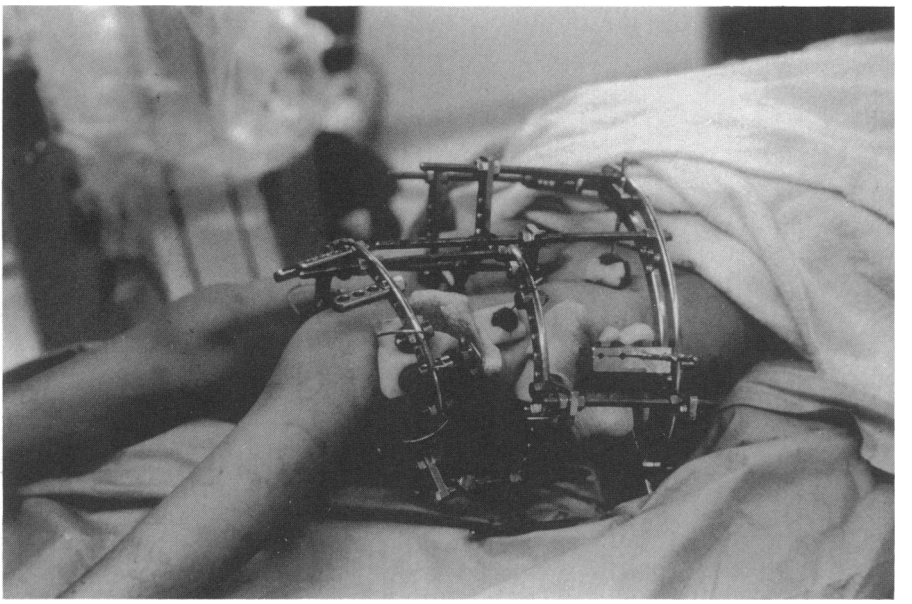

Fig. 2*c*. During correction with the Ilizarov apparatus on. Reproduced by permission from Atar, D. et al.: Treatment of complex limb deformities in children with the Ilizarov technique. *Orthopedics 14(9):* 961–67, 1991.

(1.5 mm, 1.8 mm in diameter) are used to transfix the bone. Wires are attached to external rings and tensioned; telescoping rods connect the rings to each other. If needed, two posts can be connected together in a hinged position to permit correction of angulation. In limb lengthening a percutaneous corticotomy, interruption of the bone cortex continuity with preservation of the medullary blood supply, is done followed by gradual distraction.

Ilizarov showed in his biological studies that soft tissues accommodate initially to distraction by simple stretching (10%). If the distraction force continues, neogeneosis seems to take place in muscle, nerve, vessels, and skin. The rate and rhythm of the distraction (usually 0.25 mm four times a day) affect the successful formation of bone and soft tissues.[5,6,8,9]

In 36 Ilizarov procedures we reported here, we had 37 complications. Most of them were of low morbidity (pin-site infections, premature consolidations, transient nerve injuries). Only a few were major complications (vascular injury, knee dislocation). Average increase in femoral length was 10 cm (32%), in tibial length 7.5 cm (30%), and in humerus 11 cm (40%). High incidence of complications associated with lengthening procedures is well documented in the literature,[1,4,7] but with the Ilizarov technique the average increase in lengthened segments is almost twice the length achieved in any other method.[2,3]

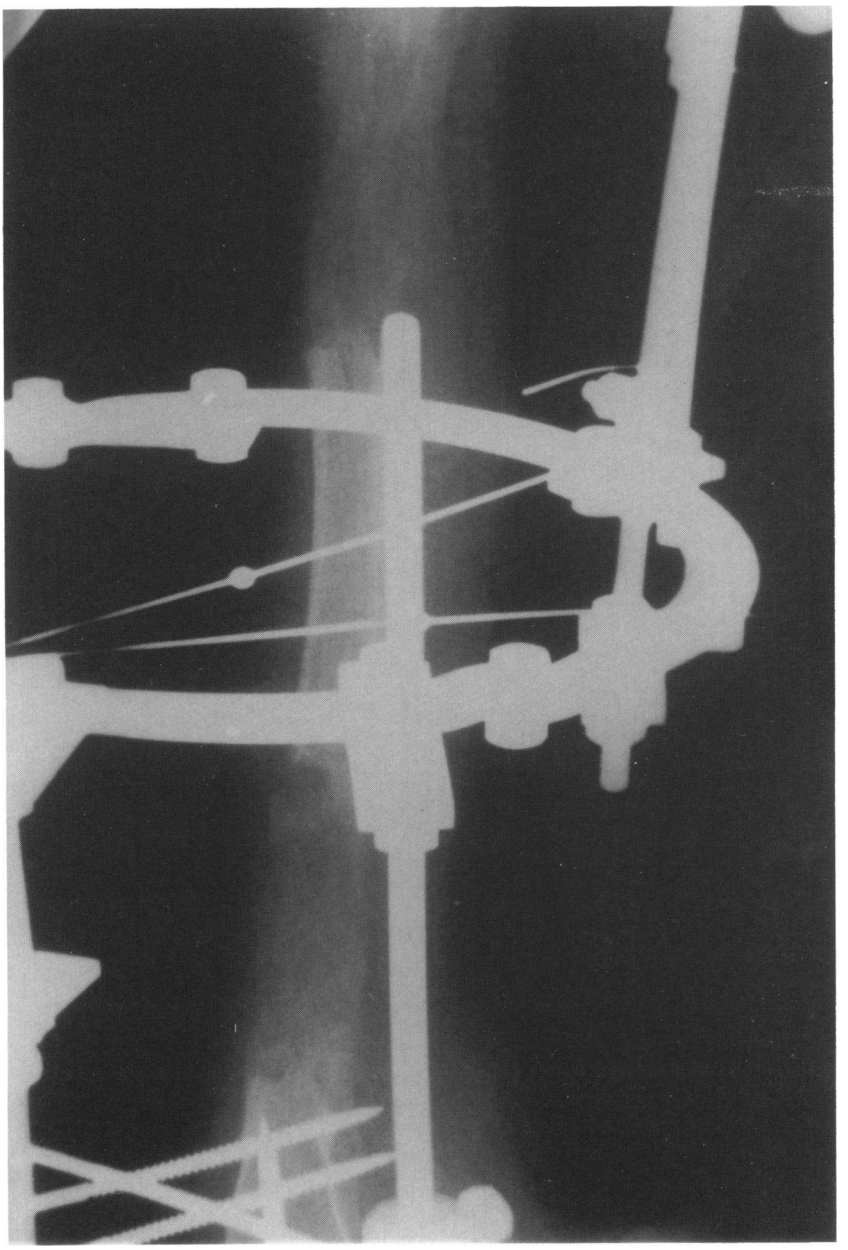

Fig. 2*d*. X-ray shows lengthened segments during the procedure. Reproduced by permission from Atar, D. et al.: Treatment of complex limb deformities in children with the Ilizarov technique. *Orthopedics 14(9):* 961–67, 1991.

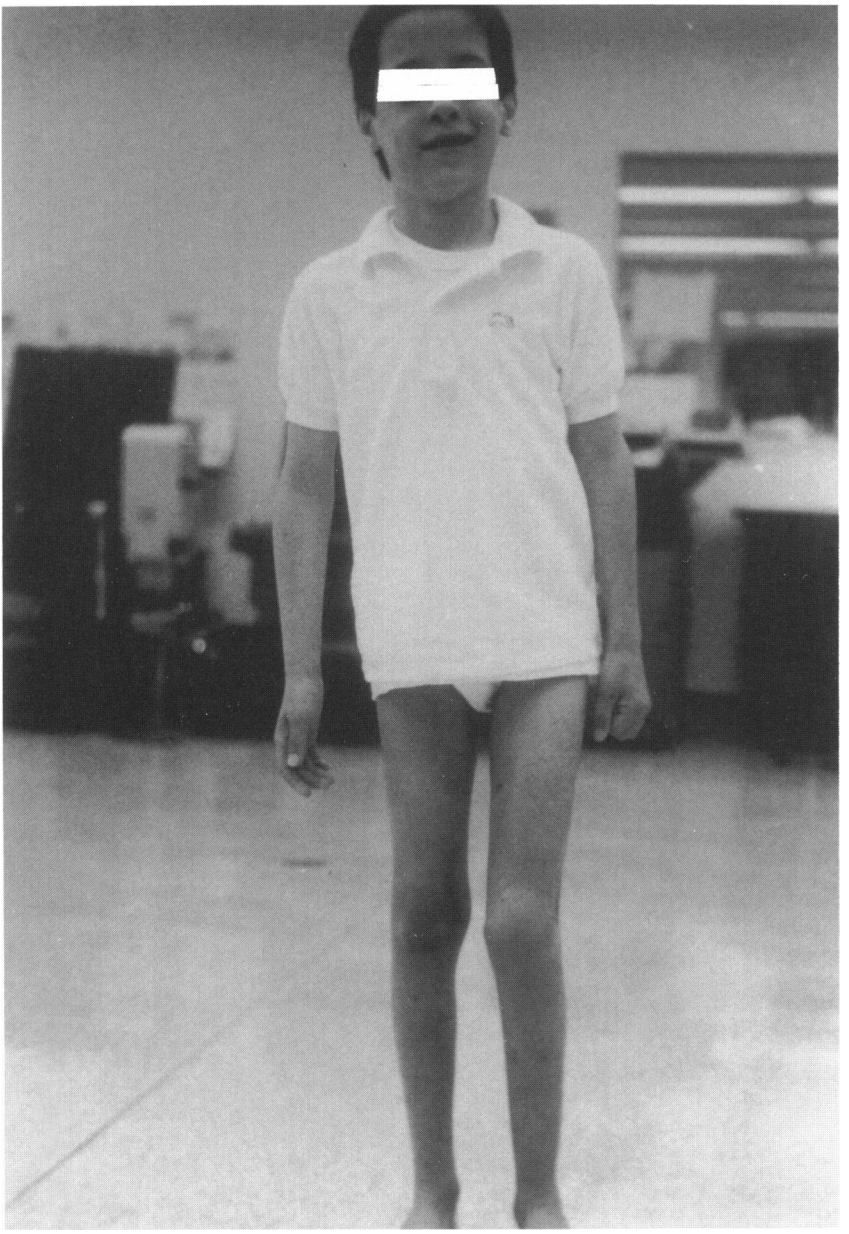

Fig. 2*e*. End results—equal limbs (knee fixed flexion contracture 20 degrees and posterior luxation

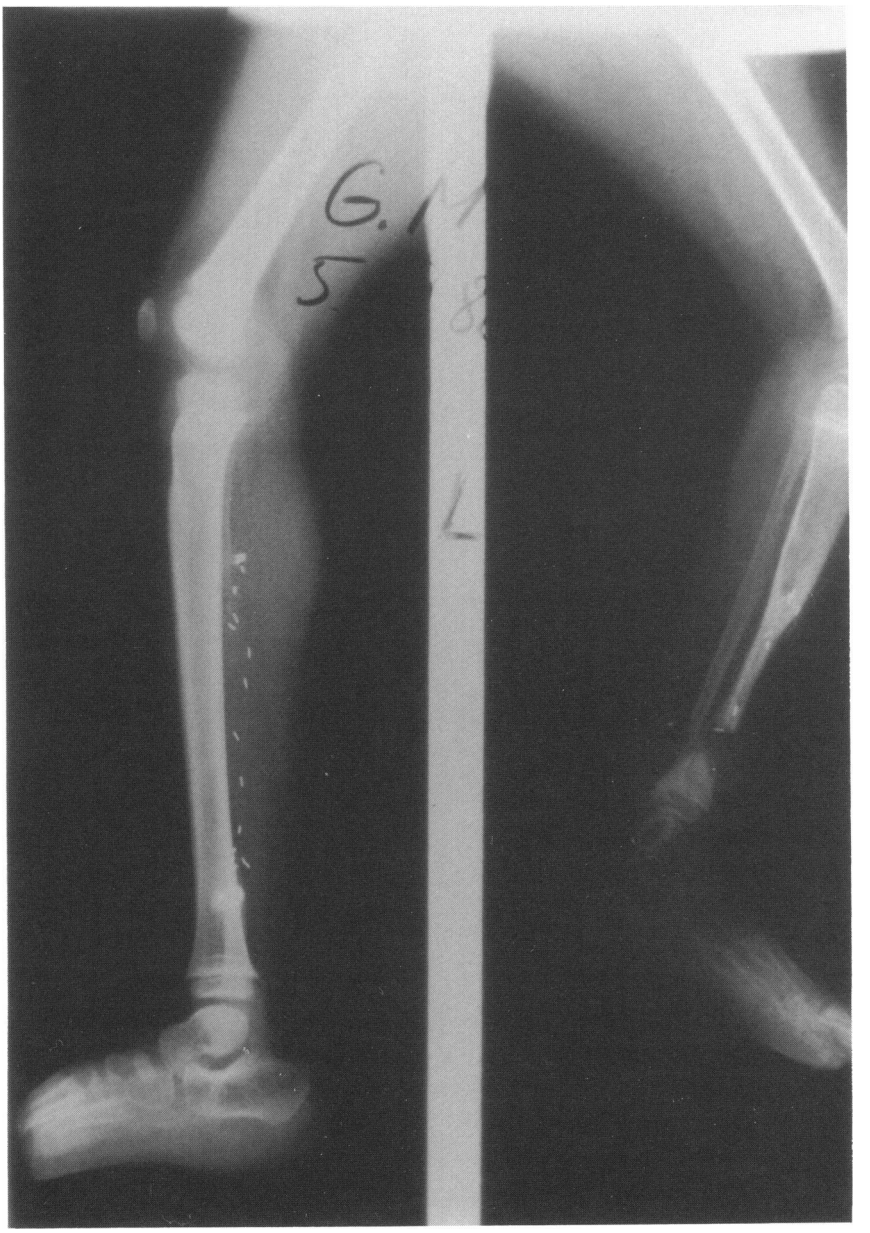

Fig. 3*a*. X-ray before treatment

Fig. 3*b*. Motion at the pseudoarthrosis site

We suggest that the Ilizarov method is particularly suitable for treating serious limb discrepancies and other limb deformities that could not be managed easily by means of standard procedures. Complete understanding of the technique and the apparatus is essential before the procedure is

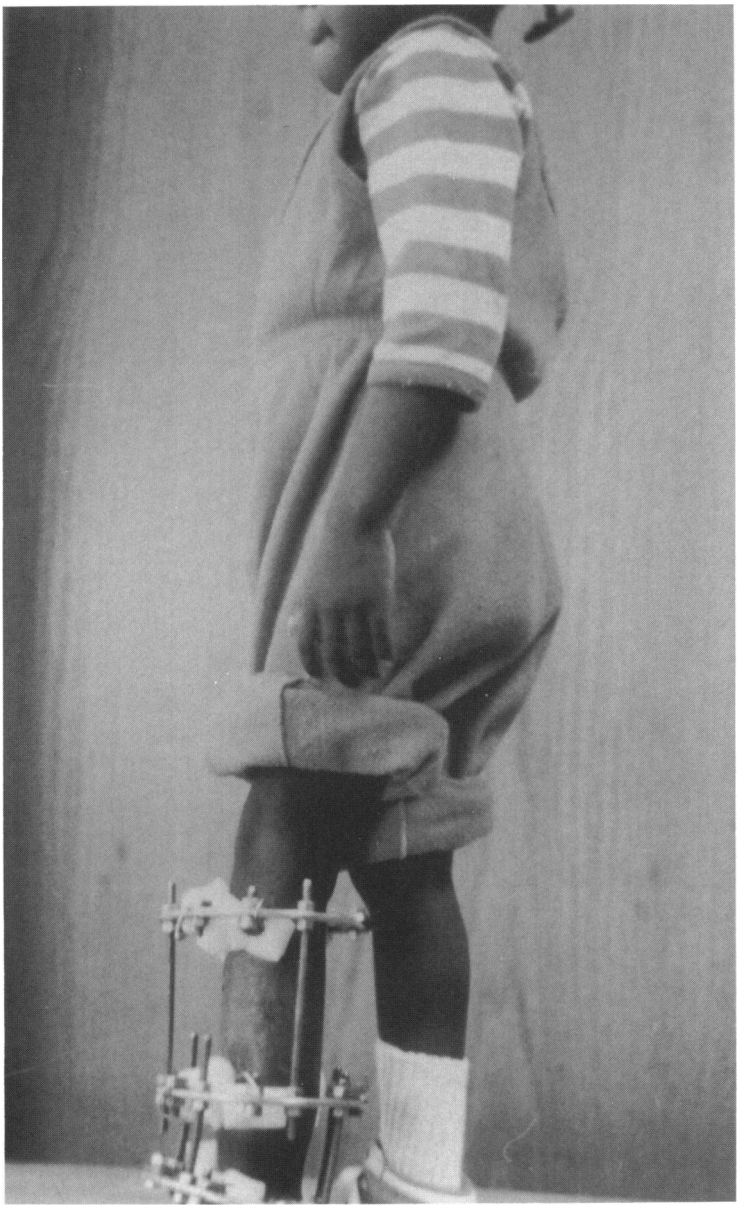

Fig. 3*c*. During procedure with the Ilizarov apparatus on

Fig. 3*d*. Leg in cast after removal of apparatus

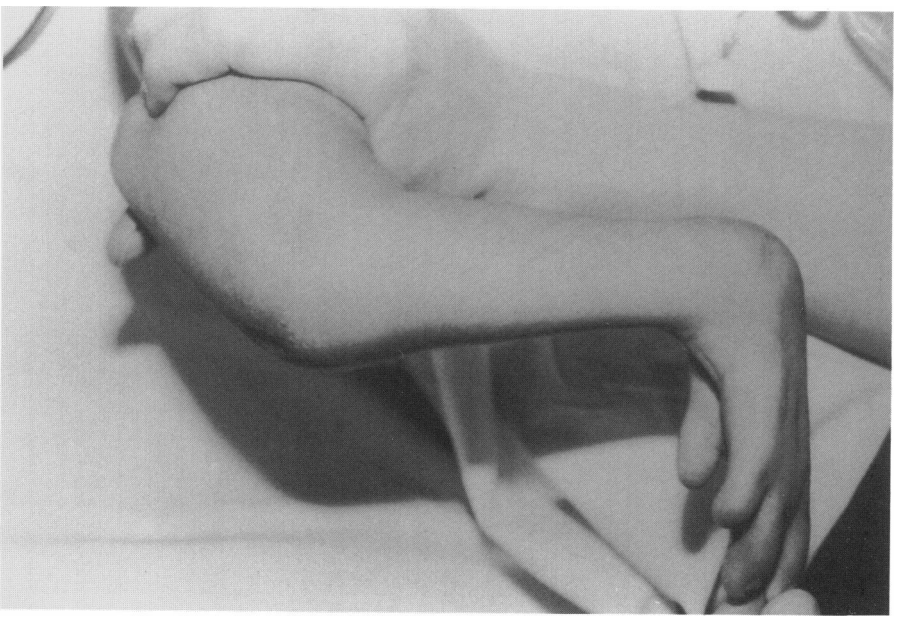

Fig. 4*a*. 90 degree flexion contracture of the wrist (Poland syndrome). Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

Fig. 4*b*. X-ray appearance. Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

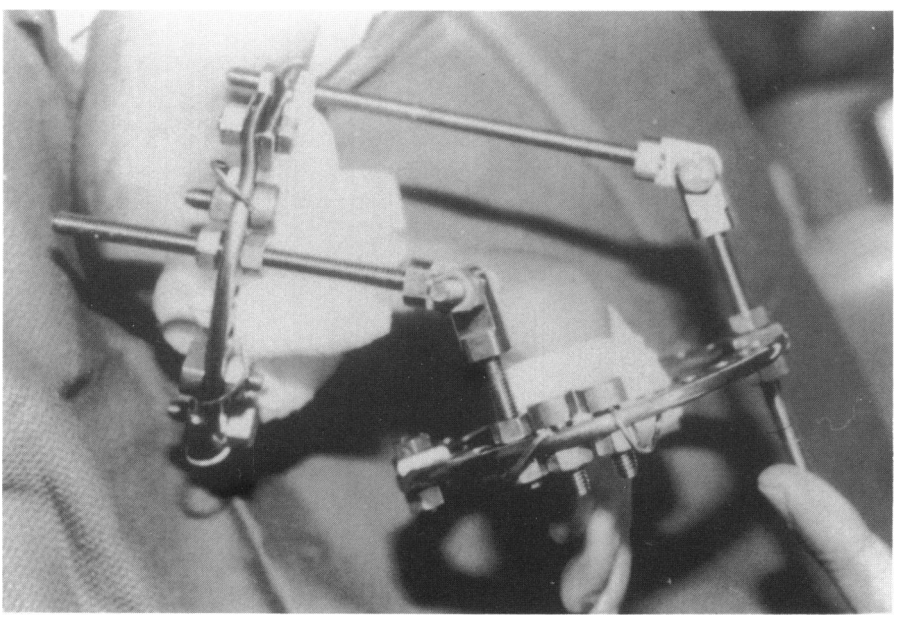

Fig. 4*c*. With the Ilizarov apparatus in place. Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

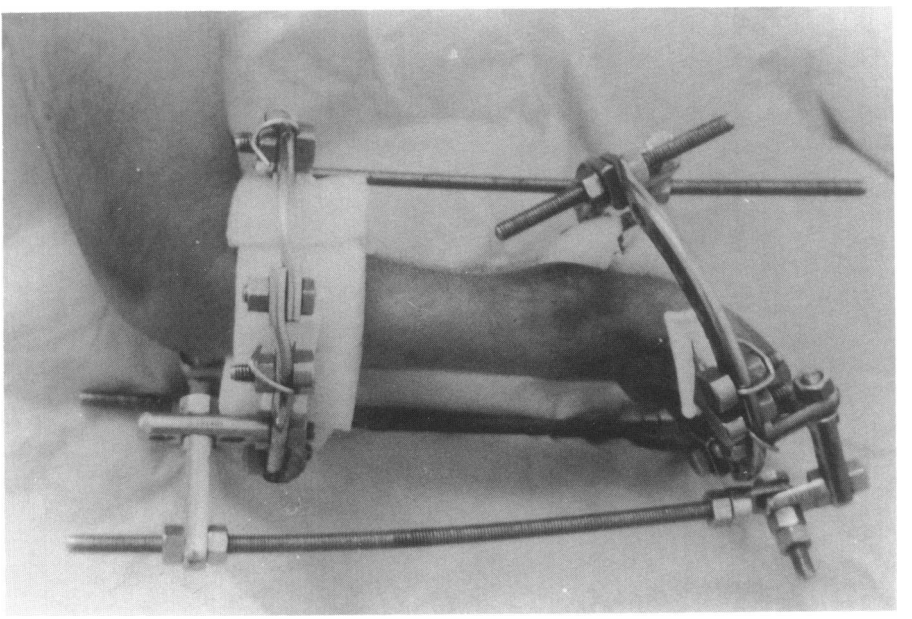

Fig. 4*d*. Three months later with Ilizarov apparatus in place. Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

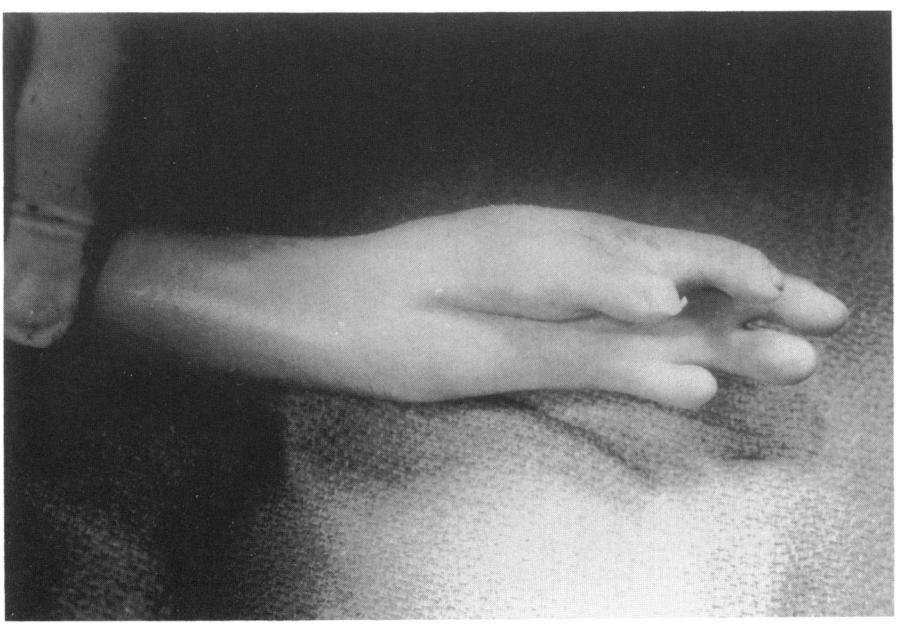

Fig. 4*e*. End result: Hand fully corrected

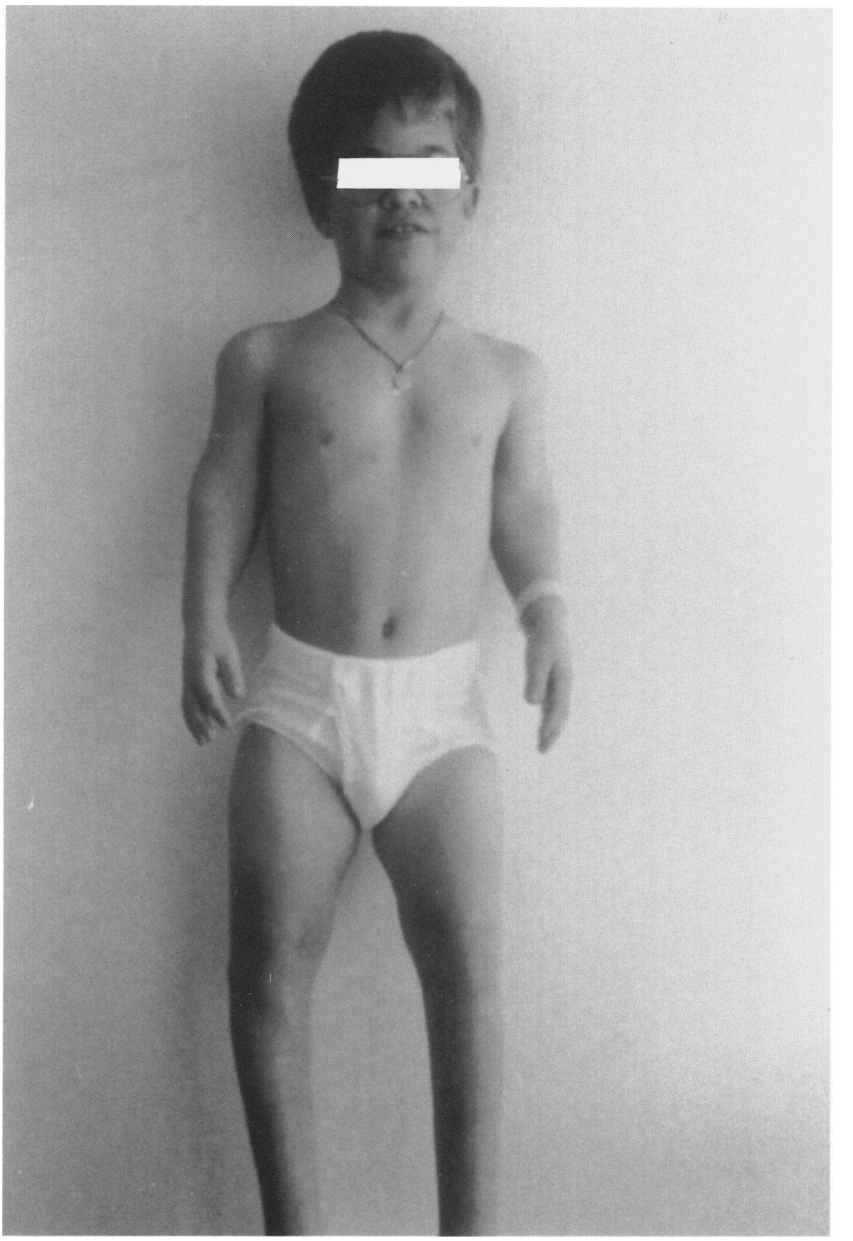

Fig. 5*a*. Patient before treatment. Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res.* 273: 268–74, 1991.

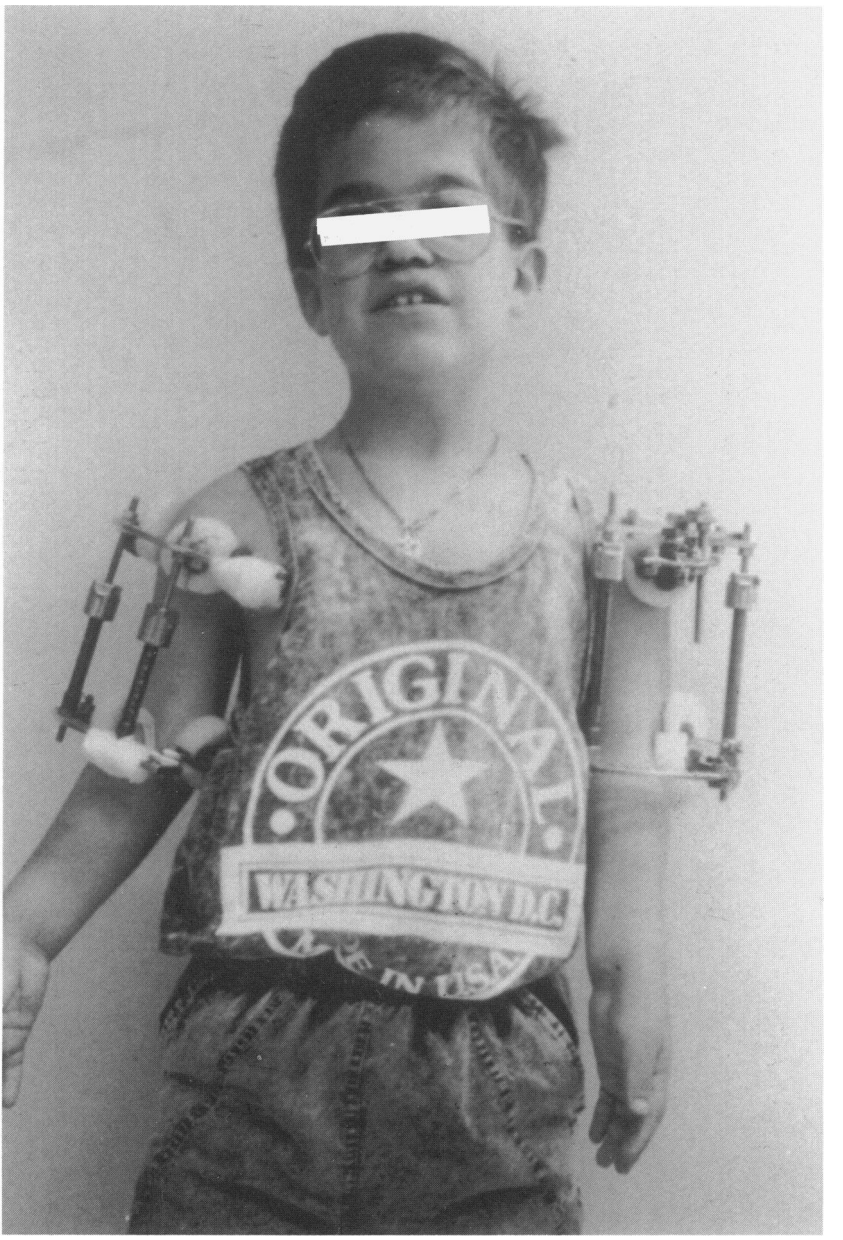

Fig. 5*b*. During the treatment with both Ilizarov apparatus on. Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

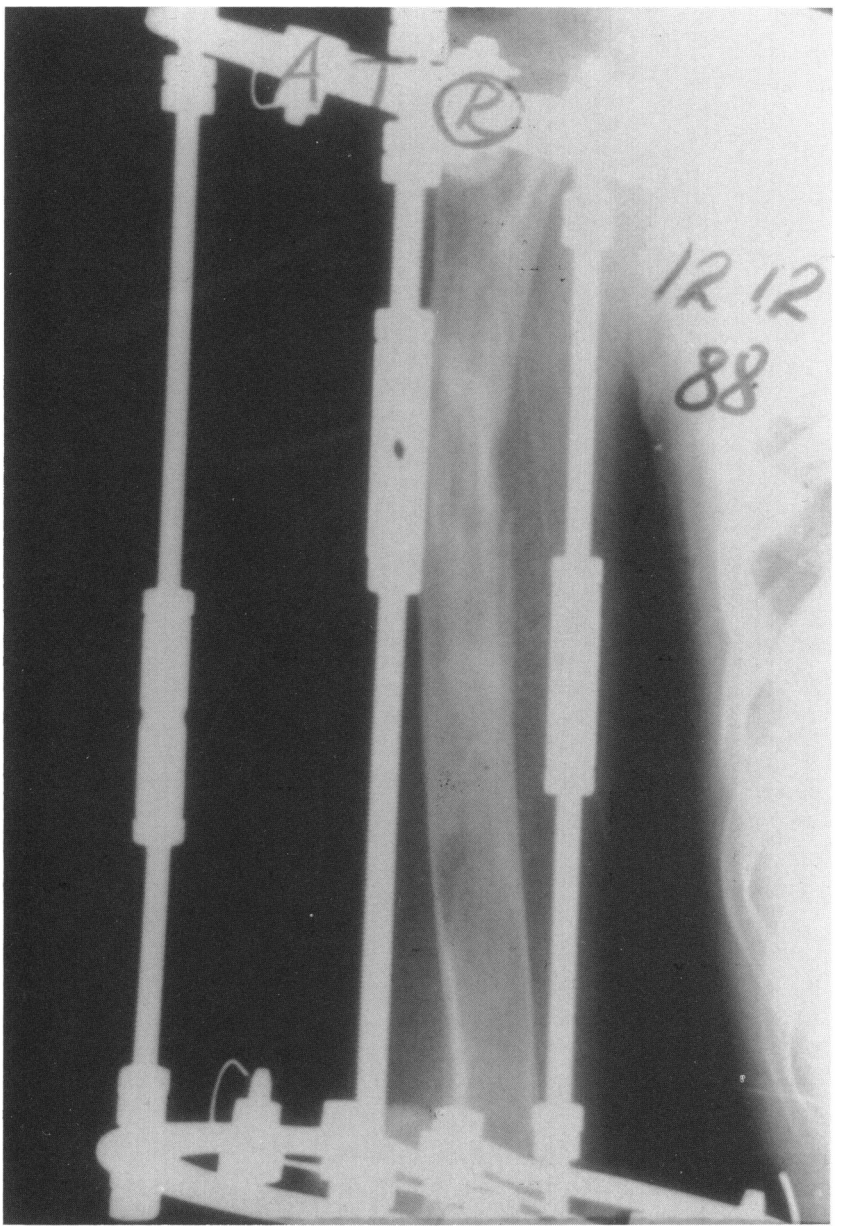

Fig. 5*c*. X-ray of the right lengthened segment (11 cm) in the apparatus. Reproduced by permission from Atar, D., et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

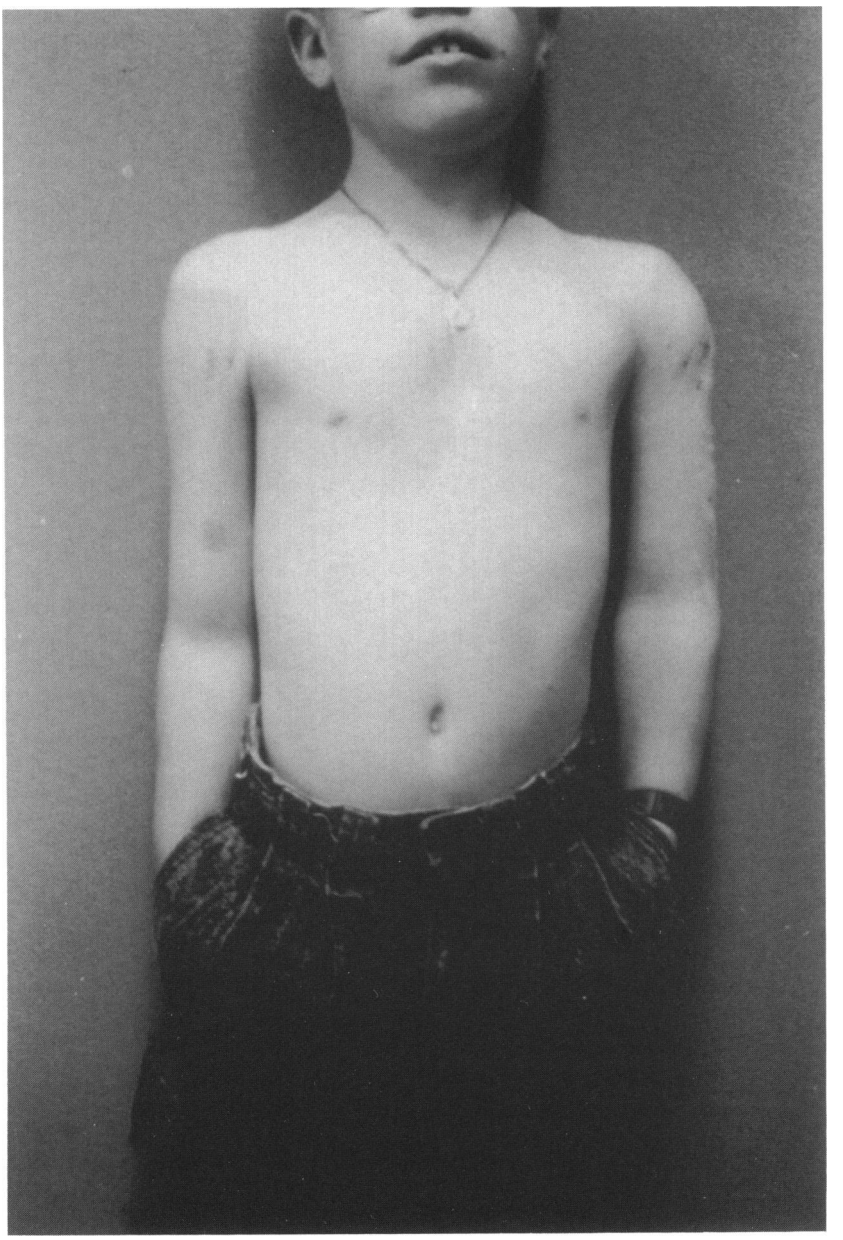

Fig. 5*d*. End of treatment patient can reach his pockets. Reproduced by permission from Atar, D. et al.: Ilizarov technique in treatment of congenital hand anomalies. *Clin. Orth. Rel. Res. 273:* 268–74, 1991.

attempted. Close monitoring of patients with intensive physical therapy are necessary for a successful outcome.

SUMMARY

A new "bloodless" technique (Ilizarov) was used to correct 36 limb deformities in 29 children. There were six leg length discrepancies, five achondroplasias, four deformed feet, five joint contractures, one rotational deformity of tibia, and in three the apparatus was used as an external fixator after corrective osteotomy. Lengthening was accomplished in 15 of the 16 procedures (93%). Average increase in femur length was 10 cm (32%), in tibial length 7.5 cm (30%), in humerus 11 cm (40%). Bony union was achieved in two out of five pseudoarthroses. Four deformed feet were fully corrected. Joint contractures were corrected in four out of five. The complication rate is as high as in other methods but with the Ilizarov apparatus, longer segments of bone were lengthened and more complex deformities were treated. Complications lessened as experience was gained.

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